

AN OVERVIEW OF POULTRY PRODUCTION IN INDIA

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The poultry sector in India has undergone a paradigm shift in structure and operation from a mere backyard activity into a major commercial agri based industry over a period of four decades. Development of high yielding layer (310-340 eggs) and broiler (2.4-2.6 kg at 6 wks) varieties together with standardized package of practices on nutrition, housing, management and disease control have contributed to spectacular growth rates in egg (4-6% per annum) and broiler production (8-10% per annum) in India. The annual per capita availability also increased to 60 eggs and 2.5 Kg of meat, consistently with increase in productivity. Chicken dominates the poultry production in India with nearly 95% of the total egg production and the rest is contributed by ducks and others. FAO classified poultry production systems into four categories based on the volume of operation and level of biosecurity, i.e., village or backyard production, commercial production with low biosecurity, large scale commercial with high biosecurity and industrial and integrated production systems. Feed accounts for 65-70% of broiler and 75-80% of layer production cost. Maize is the popular cereal used in combination with protein meal like soybean meal which generally determines the cost of compounded feed. To minimize the occurrence of disease in poultry the three most important components of disease control are bio-security, vaccination and medication. Bio-security refers to all measures taken to secure prevention of all types of pathogens in poultry farms. Effective bio-security and implementation of successful hygienic procedures are increasingly dependent on Hazard Analysis Critical Control Point approach (HACCP). There is a worldwide concern to minimize the use of antibiotics in poultry because of disease resistance and antibiotics residues in food chain. Exports of poultry produce are very low, about Rs.651crores per annum and the trade is very small in global market. Village or backyard poultry production can be advantageously promoted in rural areas, as the large commercial poultry production continues to be concentrated in urban and peri - urban locations which has proven to be powerful tool for alleviation of rural poverty, eradication of malnutrition and creation of gainful employment in vast rural areas. The poultry production in India continues to exhibit spectacular growth inspite of several challenges encountered over the years. With increasing demand for chicken egg and meat, the poultry production in India foresees further expansion and industrialization. With the advent of knowledge in different fields of poultry, the future challenges will not be a hindrance and thus sees a bright future for poultry production in this country.

Key words: Poultry production, Poultry industry, Village poultry, Diseases, Marketing, Feed resources

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Poultry is one of the fastest growing segments of the agricultural sector in India with around eight percent growth rate per annum. The poultry sector in India has undergone a paradigm shift in structure and operation which has been its transformation from a mere backyard activity into a major commercial agri based industry over a period of four decades. The constant efforts in upgradation, modification and application of new technologies paved the way for the multifold and multifaceted growth in poultry and allied sectors. The development is not only in size but also in productivity, sophistication and quality. Development of high yielding layer (310-340 eggs) and broiler (2.4-2.6 kg at 6 wks) varieties together with standardized package of practices on nutrition, housing, management and disease control have contributed to spectacular growth rates in egg (4-6% per annum) and broiler production (8-10% per annum) in India during the last 40 years. The annual per capita availability also increased to 60 eggs and 2.5 Kg of meat, consistently with increase in productivity. However, it is far below the recommended level of consumption of 180 eggs and 10.8 kg poultry meat per person per annum by Indian Council Medical Research. This transformation has involved sizeable expansions and investments in breeding, hatching, rearing and processing. India is one of the few countries in the world that has put into place a sustained Specific Pathogen Free (SPF) egg production project.

The growth of the poultry sector in India is also marked by an increase in the size of the poultry farm. In earlier years broiler farms had produced on average a few hundred birds (200-500 chicks) per cycle. Today units with fewer than 5,000 birds are becoming rare, and units with 5,000 to 50,000 birds per week cycle are common. Similarly, in layer farms, units with a flock size of 10,000 to 50,000 birds have become common. Small units are probably finding themselves at a disadvantage because of high feed and transport costs, expensive vaccines, and veterinary care services and the non-availability of credit. Some small units are reported to be shifting from layer to broiler production because output in broiler units can be realized in six weeks.

The structure of India's poultry industry varies from region to region. While independent and relatively small-scale producers account for the bulk of production, integrated large-scale producers account for a growing share of output in some regions. Integrators include large regional farms that incorporate all aspects of production, including the raising of grandparent and parent flocks, rearing DOCs, contracting production, compounding feed, providing veterinary services, and wholesaling. The southern region account for about 57 percent of the country's egg production, the eastern and central regions of India account for about 17 percent, the northern and western regions contribute 26percent of egg production.

Current scenario

India ranks 3rd in egg production and 7th in chicken meat production in the world (Watt Executive Guide, 2015). About 3.4 million tons (74 billion) of eggs are produced from 260 million layers and 3.8 million tons of poultry meat is produced from 3000 million broilers per annum in India. The Poultry Industry is contributing about Rs.70,000/- crores to the national GDP and providing employment to more than 4 million people either directly or indirectly. About 2-2.5 million tons of poultry litter, a valuable organic fertilizer, is produced as a by-product every year. The poultry industry is concentrated in certain pockets of the country. The State of Andhra Pradesh, Telangana, Tamil Nadu lead the country followed by Maharashtra, Punjab and West Bengal.

The popularity of poultry meat is on the rise during the last two decades. It is presently accounting for about 45% of the total meat consumed and is the most popular meat from any single livestock species. Chicken dominates the poultry production in India with nearly 95% of the total egg production and the rest is contributed by ducks and others (DADF, 2014). Majority of ducks are found in certain states on the eastern and southern coast like West Bengal, Assam, Orissa, Kerala, Andhra Pradesh, Tamil Nadu etc. Other species like turkeys, guinea fowls, ostriches, emus etc. are reared only in small numbers in areas having specific market demand. India is the home for many breeds

of native chicken like Aseel, Kadak Nath, Tellicherry, Haringhata Black, Nicobari, Danki etc., which are still popular among the rural and tribal areas for back yard/ free range farming (Chatterjee and Haunshi, 2014). For the commercial farming, high yielding crosses developed and supplied by the private sector like Babcock, Bovans (egg type) and Cobb, Ross, Hubbard (meat type) are being used. The crosses developed under the public sector like Krishilayer, Krishibro (multicolored broiler etc.) are popular in certain areas.

Availability of eggs is highly non-uniform in different parts of the country primarily due to wide variation in the production levels. Much of the eggs produced are consumed by the urban population while the rural and tribal areas have little access to the eggs and meat produced from the industrial sources and the availability is very low. In spite of rapid growth, the poultry industry suffered many setbacks in recent times due to rising cost of feed, emergence of new or reemerging of existing diseases, fluctuating market price of egg and broilers, etc. which need to be addressed to make the poultry sector as a sustainable enterprise.

Poultry production systems

The rapid expansion of poultry production has been associated with technological change and increasing scale of production units. More specifically, the development has involved a switch in emphasis from traditional small-scale production using dual-purpose indigenous breeds to intensive

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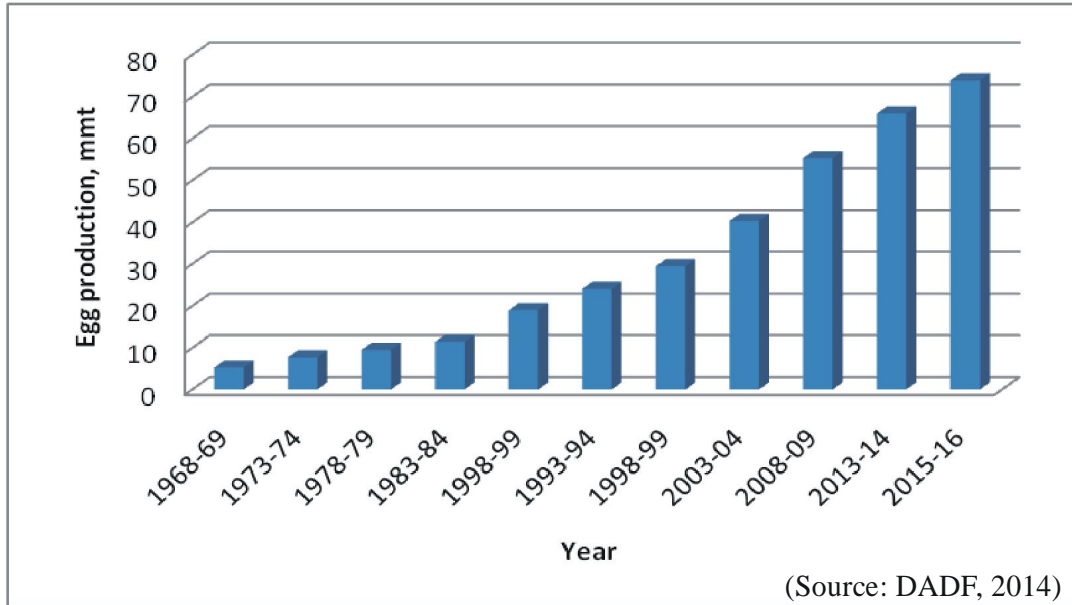


Fig. 1 . Trends in egg production over last 6 decades

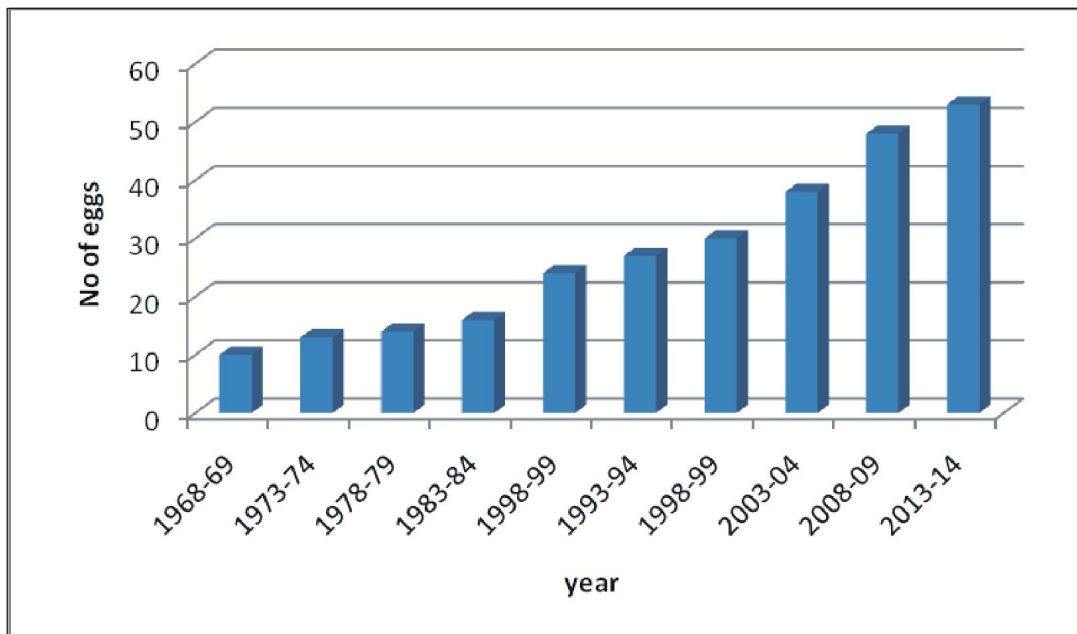


Fig. 2. Per capita availability of eggs in India

commercial production systems using hybrid birds specially bred either for meat or for egg production. The introduction of improved, exotic, genetic material is an important first step in the growth and development of the commercial poultry sector. Generally, the new strains are less hardy and less resistant to endemic diseases than indigenous birds. The greater productive potential cannot be attained without complementary inputs of specially compounded concentrate feeds, and improved housing, management, and veterinary care. Nonetheless, the introduction of new genetic material is the foundation on which other technological improvements are added.

FAO classified poultry production systems in to four categories based on the volume of operation and level of biosecurity. The four categories are better described as 'sectors' than as 'systems', as increasing commercialization is associated with increased segmentation of different stages in the value chain from input supply through to retail delivery of the product (Upton, 2007). Although formal biosecurity may be higher in industrial/commercial systems, the greater bird population density may increase the probability of infection and the scale of disease outbreaks that occur in these concentrated production systems (FAO, 2007). Increasing concentration of production is also associated with problems of waste disposal and soil, air and water pollution (FAO, 2006). Within each sector there is a great deal of variation between

individual types of production system and value chains.

Village or backyard production

India has nearly 70% of its population living in rural areas. However, in the present scenario most of the commercial poultry production is concentrated in urban and peri - urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition. Free range and small scale semi-commercial back-yard poultry production can be advantageously promoted in rural areas, as the large commercial poultry production continues to be concentrated in urban and peri - urban locations. It can be used as a powerful tool for alleviation of rural poverty, eradication of malnutrition and creation of gainful employment in vast rural areas (Sharma and Chatterjee, 2009; Rajkumar *et al.*, 2010).

The most basic and simple backyard production system involving a few hens and a cockerel is essentially a closed system. Home-produced fertile eggs are hatched to provide replacements, birds feed by scavenging or are provided with household scraps and crop by-products; there are virtually no veterinary inputs and the remaining eggs and meat produced are consumed within the household. Such very simple subsistence poultry production

systems are probably quite rare. Producers with even slightly larger flocks, generate cash income from the sale of eggs and birds within the local community. Transactions may take place directly between producers and consumers, but traders and other market intermediaries may be involved, selling on to other sectors of the poultry industry. Village or backyard production systems are widely distributed and exist in both rural and urban areas. It is estimated that today in India, about 15 percent of total poultry output is derived from “backyard” production (Landes *et al.*, 2004). In areas that are less densely populated by poultry, “backyard” systems are likely to contribute a larger proportion of total poultry production. In the village or backyard sector, production is generally based on traditional local, native breeds, producing both eggs and birds for meat. In the recent past, improved backyard varieties (like Vanaraja, Gramapriya, Srinidhi, Giriraja etc.) developed mostly by public sector and a few by private sector (like Kroiler, Rainbow rooster) are substantially contributing to the total chicken egg and meat production of the country. Nonetheless, village or backyard production can make a useful contribution to dietary protein intake and incomes of resource poor households (Acamovic *et al.*, 2005, Rajkumar *et al.*, 2010). Furthermore, given the lower opportunity costs of resources and the higher market prices offered for local poultry, backyard systems are likely to yield a positive economic

return, despite increasing competition from the commercial sectors.

Commercial poultry production with low biosecurity

This sector is based on commercial production, but it retains some characteristics of the traditional, backyard systems, particularly in selling live birds in wet markets or directly to retail shops. Production units are generally intermediate in scale between backyard systems of up to 200 birds and commercial systems of 10,000 to 50,000 birds. Levels of biosecurity are low, in that birds are often not permanently housed, mixed flocks of chickens and waterfowl may be kept, birds are generally marketed live, and a range of different markets, un-monitored for health risks, are used for produce sales and input supplies (Upton, 2007). The flocks are generally reared either for broiler meat production or for egg production. Feed is generally purchased either as premixed rations or as raw materials for home milling and mixing. In India, the smaller independent commercial producers are of regional importance in the north and east of the country, where integrated contract production has not become established. Market limitations arise in countries, like India, where there is a consumer preference for live birds, rather than dressed, chilled or frozen carcasses. In India, it is suggested that relatively small-scale producers are at a disadvantage in facing high feed and transport costs, limited access to vaccines

and veterinary services, and shortage of credit (Upton, 2007)

Large-scale commercial with high biosecurity

This sector consists of the generally larger-scale (50,000 to 1.00 lakh birds) commercial flocks of broilers, layers or breeding birds. Only relatively wealthy individuals or commercial joint-stock companies have the necessary investment funds or can raise sufficient credit for these larger-scale investments. Biosecurity levels are defined as high, as birds are continuously housed, strictly preventing contact with other flocks or with wildlife. Despite this, many outbreaks of HPAI appear to have started in large-scale commercial flocks. Inputs are generally supplied and products marketed through formal market agencies. The scale and intensity of production is substantially higher in the commercial and industrial sectors than in backyard systems. Advantages are derived from economies of scale, providing scope for specialization and division of labour between the different stages in the production process, leading to automation of operations and labour-cost savings. These advantages add to those derived from the use of highly productive commercial hybrid chicks and improved technologies such as the evaporative cooling or air-conditioning of poultry houses. The four southern states, where poultry densities and flock sizes are high, together contribute 57 percent of the nation's egg production (FAO, 2007).

Industrial and integrated production

This sector consists of the largest and most industrialized (more than 1.00 lakh birds) enterprises in the poultry industry. The various stages in the value chain are vertically integrated into a single industrial company. The broiler or layer components are either fully integrated as part of the parent company, or are separate production units operating under contract to the parent company, it has been assumed that although the whole process, from chick breeding and hatching through to distribution and retailing is integrated in a single organization, feed milling remains as a separate business enterprise. In many instances, the feed and poultry production activities are integrated, together with 'horizontal' links to other sectors. In other cases, vertical integration is partial – from breeder down to broiler grower, or from market distributor up to broiler producer. Vertical integration yields financial benefits by reducing the operational costs at different stages of the value chain. In non-integrated poultry systems, transaction costs are likely to be high because of: (1) frequency and regularity of transactions resulting from the cyclical nature of poultry production; (2) the risks of disease and market price fluctuations; and (3) the investment in very specific types of assets, or 'asset specificity', involved in poultry production, processing and marketing (Williamson and Masten, 1995; Dorward *et al.*, 1998). In these circumstances, the vertical integration of the different stages of the breeding, production, processing and

marketing of poultry produce is a rational economic response, which should increase efficiency and reduce unit costs. In India, substantial numbers of integrated poultry production companies have been established, particularly in the four southern states (Landes *et al.*, 2004).

The introduction of improved, exotic, genetic material is an important first step in the growth and development of the commercial poultry sector. Generally, the

new strains are less hardy and less resistant to endemic diseases than indigenous birds. The greater productive potential cannot be attained without complementary inputs of specially compounded concentrate feeds, and improved housing, management, and veterinary care. Nonetheless, the introduction of new genetic material is the foundation on which other technological improvements are added. The dynamic changes and trends in poultry are presented in Table 1 and 2.

Table 1. Trends in layer industry

SI No	Parameter	1990	2015
1	Layers (crores)	10	26
2	Eggs per hen	260	330
3	Separate brooding (%)	10	80
4	Feed automation (%)	10	80
5	Feed price (Rs) per Kg	12	22
6	Egg price (Rs)	1.5	3.2
7	Eggs cleaning and packing	No	Important

Table 2. Trends in broiler industry

SI No	Parameter	1990	2015
1	Broiler parents housed (crores)	0.7	3.4
2	Broilers placements per month	5	25
3	FCR	2.2	1.6
4	Feed price per Kg (Rs)	20	28
5	Body weight (kg) 42 days	1.5	2.5
6	Broiler price / Kg live(Rs)	25	70
7	Broiler integration	0	60
8	Slaughter age	48	38
9	Antibiotics	Nil	50

Native chicken and their conservation

A total of sixteen native chicken breeds have been recognized and registered as indigenous breeds of chicken in India (Table 3). Among them, most popular breeds are Aseel, Kadaknath, Haringhata Black, Nicobari, Ghagus, Tellicherry, etc.

chickens are also of nondescript type (Chatterjee and Haunshi, 2014).

Some of the native chicken breeds of India are under threat of extinction due to various factors including incidence of diseases like Avian Influenza and other emerging and re-emerging diseases. Therefore, it is

Table 3. Registered native chicken breeds of India

Sl. No.	Breed	Home Tract
1	Ankaleshwar	Gujarat
2	Aseel	Andhra Pradesh, Orissa and Chhattisgarh
3	Busra	Gujarat and Maharashtra
4	Chittagong	Meghalaya and Tripura
5	Danki	Andhra Pradesh
6	Daothigir	Assam
7	Ghagus	Andhra Pradesh and Karnataka
8	Harringhata Black	West Bengal
9	Kadaknath	Madhya Pradesh
10	Kalasthi	Andhra Pradesh
11	Kashmir Favorolla	Jammu and Kashmir
12	Miri	Assam
13	Nicobari	Andaman & Nicobar
14	Punjab Brown	Punjab and Haryana
15	Tellichery	Kerala
16	Mewari	Rajasthan

(Source: <http://www.nbagr.res.in/regchi.html>)

Some of the lesser known native chicken ecotypes reported in the literature are Kumaon hill fowl, Tripura black, Titri, Teni, Brown Desi, besides native chickens / ecotypes with major genes such as naked neck and frizzle. Large chunk of native

essential to take steps to conserve them. In situ conservation is the most ideal and preferred method of conservation of biodiversity of any germplasm. However, due to increasing urbanization there is increasing pressure on agricultural and

fallow lands leading to high cost involvement and hence it is becoming difficult to conserve native chicken at their native tracts. Furthermore, introduction of exotic/improved germplasm is diluting or eroding the genetic base of native chickens. Alternatively, ex-situ conservation measures can aid in situ conservation of germplasm as it acts as insurance policy in the event of extinction/dilution of the native chickens. Native chickens so conserved could be used in future in recovery/reintroduction programs. However, ex-situ conservation in poultry species is a difficult task (Chatterjee and Haunshi, 2014).

Feed Resources

Success on poultry production rests primarily on the quality of the bird employed, comforting environment and provision for good feed, the last being most expensive of all other inputs, deserves befitting attention. Feed accounts for 65-70% of broiler and 75-80% of layer production cost. Maize is the popular cereal used in combination with protein meal like soybean meal which generally determines the cost of compounded feed. Production of maize increased from 9.65 million tons in 1989-90 to only 24.4 million tons in 2015. Similarly, soybean meal production increased to 11.35 million ton in 2015 from 3.52 million tons in 1999-2000. Average increase in maize availability has been 3.8% per annum which is far below the growth rate of egg or meat production. Thus, there is a need to increase the production of maize

and soybean or explores the usefulness of other alternate energy and protein rich feedstuffs to maize and soybean meal, respectively, in poultry diets.

In view of the large gap between the demand and availability of feedstuffs for poultry production, a holistic approach is needed to meet the demand of ever growing poultry industry. Some of the approaches in these respects are

- **Identification of newer feed resources** - Since the production of cereals and oil seeds may not increase significantly, the availability of grain and oil seed meal to feed industry is expected to decrease. This would lead to escalation in the cost of feed ingredients and consequently the cost of eggs and meat. To some extent such a situation can be corrected by developing strains that need less feed input. However, alternate feed ingredients that are not related to human consumption and available in plenty should be identified and their suitability should be tested including the economic aspects.
- **Utilization of structural carbohydrates and phytate phosphorus** - With the advancement of technology, the reduction in dependency of poultry

on the storage plant carbohydrate, protein or other nutrient and to allow them to make greater use of structural carbohydrates and other nutrients. Hence the dimension from research should change from as such providing feed than technologies that utilize feed better. There are many components of feed such as β -glycans, pentosans, mannans, cellulose, lignin and phytic acid which cannot be digested by poultry under normally. These non digestible feed ingredients frequently generate digestive stress in poultry with a consequent reduction in nutrient utilization and wet litter problems. These problems could be largely alleviated by use of feed enzymes.

- **Overcoming limitations of Agro-industrial byproducts and unconventional feed stuff** - The nutritive value of a variety of maize and soybean meal replacers has been examined and despite their potential, the utilization in practical formulations is negligible due to constraints imposed by several anti-nutritional, technical and socio-economic factors. These constraints need to be resolved by the feed industry utilizing the services of scientists, planners and policy makers.

Disease management

Management of diseases in poultry plays an important role for the progress of the industry. Birds in the commercial farms are reared in open sided houses and maintained under optimum management conditions. Birds are reared under veterinary supervision. Vaccination is regularly practiced to protect the bird against diseases. In spite of all the measures, the poultry industry in India suffered a major setback last year due to the outbreak of Avian Influenza. The industry suffered serious trade losses following downfall in consumption of poultry meat and eggs for about 6 months.

To minimize the occurrence of disease in poultry the three most important components of disease control are bio-security, vaccination and medication. Bio-security refers to all measures taken to secure prevention of all types of pathogens in poultry farms. Effective bio-security and implementation of successful hygienic procedures are increasingly dependent on Hazard Analysis Critical Control Point approach (HACCP). The principles of HACCP such as hazard analysis, critical control points, critical limits, correction, recording and verification should be strictly followed for analyzing risk assessment and risk management. Vaccination should be practiced regularly following the regulatory procedures.

Priorities for effective disease management in making the poultry industry a sustainable enterprise are

- Trans-boundary disease – Many of the diseases which are not endemic to India (Avian Influenza, VVND) may enter through germplasm and biologicals. This need strict quarantine measures.
- Establishing and strengthening surveillance and monitoring system – The surveillance and monitoring system should be carried out in established laboratories. There is need to establish a National Avian Disease Laboratory with all modern facilities for surveillance and monitoring of infectious disease in poultry.
- Diagnoses through genomic approach – Efforts may be made to develop new diagnostics and biological using genomic approaches for rapid and accurate diagnosis and effective control of poultry disease.

Impact of climate change on Poultry

Climate change is a shift in the average weather condition in a given area over a period of time. The change is persistent in the mean of climate parameters viz., temperature, rainfall, humidity and soil moisture (Alade and Adamola 2013).

Carbon dioxide (CO₂), Methane (CH₄), Nitrogen oxide (N₂O) and other green house gases increased as an outcome of climate change. Climate change in many parts of the world adversely affects socio-economic sectors which include water resources, agriculture, forestry, fisheries animal husbandry and poultry. Farmers are facing a lot of challenges due to climate variation and it may not be clear in empirical terms what loss farmers incur but it is known to cause more harm to their production. Livestock production accounts for 18 percent of global anthropogenic Green House Gases (GHG) emissions of which cattle contribute major share, while poultry contributes only 8% to the livestock emissions (Steinfeld *et al.*, 2006). Poultry (chicken) are more vulnerable to climate change because birds can only tolerate narrow temperature ranges. In the 20th century, there was an increase of 0.65 °C in the average global temperature and 0.2 % to 0.3 % increase of precipitation in the tropical region. Poultry are not well adapted to high ambient temperatures because they lack sweat glands. The internal body temperature of chickens (41-42°C) is higher than that of mammalian livestock and humans (36-39°C). Poultry have considerably less threshold to heat stress as compared with other animals.

The importance of animal responses to environmental challenges applies to all species. However, poultry seems to be particularly sensitive to temperature-associated environmental challenges,

especially heat stress. It has been suggested that modern poultry genotypes produce more body heat, due to their greater metabolic activity. In general, different types of birds react similarly to heat stress, expressing some individual variation in intensity and duration of their responses. Birds subjected to heat stress conditions spend less time for feeding, more time for drinking and panting, as well as more time with their wings elevated, less time moving or walking, and more time resting. Increased temperature had significant adverse effects on both broiler and layer production. Heat stress impairs overall poultry meat and egg production by modifying the bird's neuro-endocrine profile both by decreased feed intake and by activation of the HPA axis. This leads to reduced feed intake, excessive panting to maintain thermo regulation and diverting more energy towards homeostasis instead of growth and production. However, even though the detrimental effects of heat stress in broilers seem to be very consistent, it is important to consider that stocking density has a major role as a potential compounding factor, both from the standpoint of productivity as well as welfare. The chronic heat exposure negatively affects fat deposition and meat quality in broilers, in a breed-dependent manner.

Maintaining the in house temperatures is very important for sustaining the productivity from the birds. In extreme summers, summer management through

spreading the paddy/wheat straw on roofs and sprinkling water on the roofs maintains the temperatures. Effective cross ventilation, use of coolers and foggers is also recommended. In winters, generally gunny bags are used to cover the sides especially in high raised poultry houses.

Nutrition management can also allow improvement to feed conversion ratios through optimal diet balancing and feeding regimes, and improvement to feed digestibility. Feeding the antioxidants like vitamin E, plant extracts and trace minerals like selenium, chromium, zinc etc. reduces the stress condition and improves the heat tolerance in birds. Many researchers formulating feeds that closely match the nutritional requirements of birds in their different production and growth stages to reduce the amount of nutrients excreted.

Food safety

Reduction of antibiotics use in animal feed demands substantial improvement of herd health issues, but also sensible and professional management of the antimicrobial drugs is necessary to prevent the threats of antibiotic resistance in human being. Antimicrobial drugs may be used for effective therapeutic and prophylaxis purposes, but the pulsing or continuous use of antibiotics in-feed has been severely questioned, besides public health issues, because of the consequences in intestinal microbiota and the gastrointestinal barrier harmonic function. There is a worldwide

concern to minimize the use of antibiotics in poultry because of disease resistance and antibiotics residues in food chain. In such case suitable alternatives need to be explored, which could be beneficial and cost effective. Many products of such nature like probiotics, gut acidifiers, immunomodulators, eubiotics, organic acids etc. are available in the market, but need further research. Ensuring safe food is paramount for the protection of human health and for enhancement of the quality of life. Safe food plays an important role, whether domestically produced and consumed, imported or exported. In addition, the production of safe food represents an opportunity for income generation and market access. Over the last decades, the food chain approach has been recognized as an important step forward to ensure food safety from production up to consumption. This approach requires the commitment of all players in the food chain, involving producers, traders, processors, distributors, competent authorities as well as consumers. The role of animal feed in the production of safe food is also recognized worldwide, and several events have underlined its impacts on public health, feed and food trade, and food security. Concerns prompted by the outbreak of bovine spongiform encephalopathy (BSE), and other more common food problems associated with *Salmonella*, enterohaemorrhagic *Escherichia coli* and other contaminants, have encouraged professionals and the feed industry to

scrutinize more closely the causes of these diseases and methods for their control.

Marketing

Though, commercial production of eggs and chicken meat on scientific principles has been well standardized, marketing of eggs and broiler meat are not fully organized except few in urban sectors. Eggs are still transported in open condition and in un-refrigerated vehicles. Eggs are sold as commodity in India and purchased by consumers mostly from shop next door for daily needs. Eggs are channeled through wholesale dealers, sub-dealers, retailers etc. in two to three stages, which raises the cost of eggs by 10-15% over the actual sale price at producer's place. Broilers are sold live or slaughtered at the place of sale. Sometimes the birds are dressed and displayed for sale in the open air without any concern for hygiene. Similarly eggs are sold in open without consideration for preservation of their quality. Seasonal variations in consumption and demand of eggs and meat pose greatest challenge to the stabilization of prices. The fluctuations at times go to the extent of up to 25-30% in a short period of 3-4 weeks. Thus, there is a need to strengthen the marketing system. Some of the approaches in this direction are

- Development of reliable and stable market chain round the year for marketing of poultry products.

- Facilities for hygienic slaughter and preservation of eggs should be made available at market places in both urban and rural areas.
- Formation of producer co-operatives/ associations and rural market yards will help in proper marketing.
- National Egg Coordination Committee, a farmers' cooperative agency has been contributing to the improvement in marketing of eggs. However, more systematized marketing strategy and the state's involvement in minimizing the channels are required for making poultry farming remunerative and cost effective in the years to come.
- Because of the location of farms in urban and peri-urban areas that too concentrated in few states, availability of eggs and chicken meat are high in these areas only, but in rural areas and rest of the country the availability is low. Thus, there is a vast scope to tap the rural markets and remote areas of the country where availability is low.

Processing and exports

Trading of chicken in India is primarily done in number and not by weight at the wholesale level. Live and fresh dressed

broilers account for the bulk of sales and sale of processed meat is limited (below 10%). However, acceptance of processed chicken is on the rise, particularly in the urban markets. Due to pollution and environmental concerns, slaughtering of birds under unhygienic conditions at open places is being discouraged. Thus, the sale of slaughtered chicken is expected to increase. Hence, there is a need to develop processing facilities. Hence, there is an urgent need of many chicken processing plants in the near future and sale of processed chicken to increase both to cater domestic as well as export markets.

A few plants for processing eggs have been installed using state of the art machinery in some states with an average daily turnover capacity of 0.7 - 0.8 million eggs. Whole egg powder, yolk powder, egg weight powder, lysozyme etc. are being produced under high standards of operation. Egg powder from India is well accepted in EU, Japan and Far-east. However, to tap the international market there is a need to establish many more egg processing plants. It has been told that India is geographically ideally located to cater to the Middle East and far eastern countries for shell eggs. Therefore vast scope exists to increase the export of shell eggs from India to these countries.

Exports of poultry produce are very low, about Rs.651 crores per annum and the trade is very small in global market (Shukla and Nayak, 2015). At present mainly table eggs (UAE, Kuwait and Oman), hatching eggs

(UAE, Oman and Kuwait) and egg powder (Japan, Poland, Belgium and UAE) are exported from India. Our major markets Middle East and Asia. Egg powder is exported to Japan and EU. India has infrastructure to export eggs including all primary packaging mechanism and cold chain to deliver top quality produce to customers.

Organic poultry production

Consumer awareness is growing in terms of organic food products in recent years as almost all the food ingredients are grown under intense production systems which utilize lot of chemicals and pesticides to control the pests and diseases. Organic farming can be defined as an approach to agriculture where the aim is to create integrated, humane, environmentally and economically sustainable agricultural production systems producing acceptable levels of crop, livestock and human nutrition, protection from pests and diseases, and an appropriate return to the human and other resources employed (Lampkin, 1997). Maximum reliance is placed on locally or farm-derived, renewable resources and the management of self-regulating ecological and biological processes and interactions. The usage of chemical and other external inputs are reduced as far as possible. Organic agriculture is known as ecological agriculture, reflecting this reliance on ecosystem management rather than external

inputs. In India free range farming is considered to be organic if birds are reared without any medication and other feed compounds. Some of the important aspects of organic poultry are as follows-

- Management of poultry under backyard / free-range. For supplementary feeding, organically produced feed ingredients should be given. For medication, if any, herbal products may be used.
- Maintenance of health through preventive management, biosecurity and good husbandry practices to preventive treatment, thereby reducing the potential for the development of resistance to therapeutic medicines as well as contamination of workers, food products and the environment.
- Housing systems which allow natural behaviour patterns to be used and give high priority to animal welfare considerations, with the emphasis on free-range systems for poultry.

Value addition in Poultry

Value addition in poultry plays an important role in increasing the profits. The value addition may be through nutritional manipulations, processing and transgenesis. Omega-3 enriched eggs and meats are available in the market for premium price developed by nutritional approaches.

Feeding the chicks with rich sources of omega-3 fatty acids will aid in increasing the levels of omega-3 fatty acids in eggs and meat of the birds. Experiments on fortification of Zinc and Vitamin B₁₂ in chicken egg and meat through dietary manipulation for enhanced value addition and shelf life are going on and need commercialization. The second one is through biotechnological approaches, where in the gene (inter species) responsible for specific trait can be made through transgenesis. However, this approach is still in primitive stage where in research is being carried out. The commonly utilized method for value addition is processing of the poultry products. By value addition low valued meats and by products can be processed into a highly nutritious finished product adding to the returns.

Welfare concerns in Poultry

Welfare of poultry has become an important issue in recent days since EU banned cage rearing of birds. Animal welfare activists increasingly argue that rearing of these high producing and rapid growing birds in intensive system of rearing resulted in some of the welfare and health issues which were not apparent in slow growing extensively reared birds. Animal welfare activists allege that the welfare of birds reared particularly in conventional cages (CC) is compromised. The space provided in CC is not sufficient for birds to do normal

activities such as to stand, lie down, and turn around without touching each other and sides of the enclosure (Chatterjee and Haunshi, 2015). The birds kept in CC do not have sufficient space to express their natural or highly motivated and comfort behaviours. Highly motivated or internally driven and comfort behaviours in laying hens are nesting behaviour, preening, dust bathing, wing flapping, wing stretching, foraging, pecking, etc. Wing flapping is often referred to as “comfort” (stretching) behaviour. Wing flapping requires more space than wing stretching (one wing stretched downward) and wing raising (slight elevation of both wings). All these behaviours are not seen in birds kept in conventional cages.

Broilers are reared mostly on floor in open sided houses for a short period of time i.e. up to 6 weeks of age. Hence, welfare issues in broiler production are entirely different. Genetic selection for higher body weight over the last 50 years resulted in increase in growth rate by over 300% from 25 g per day to 100 g per day (Nicol, 2013). This phenomenal increase in growth rate of broilers resulted in emergence of metabolic disorders such as ascites and sudden death syndrome (Bessei, 2006). Other welfare problems are leg disorders and lameness in the fast growing broilers and hunger in the broiler breeders (Weeks and Butterworth, 2004). Extreme hunger in broiler breeders due to feed restriction to prevent accumulation of fat and in-turn affecting

the egg production is considered to be one of the welfare concerns in broiler breeders. Incidence of contact dermatitis (Pododermatitis) that includes hock burns, breast blisters and foot pad lesions is considered to be another welfare issue.

Policy makers should consider both positive and negative aspects of the problem before making a decision on the issue related to cages. A layer bird producing 330 eggs annually in a conventional cage and a broiler growing at rapid rate (2.5 kg in 42 days) in itself is very good example that the birds are quite comfortable. One cannot imagine a spectacular productivity from birds if the birds are under stress or uncomfortable (Chatterjee and Haunshi, 2015).

Challenges

In spite of rapid growth, the poultry industry suffered many setbacks in recent times due to rising cost of feed, emergence of new or reemerging of existing diseases, fluctuating market price of egg and broilers, etc. which need to be addressed to make the poultry sector as a sustainable enterprise. Issues relating to animal welfare and environmental pollution by poultry units have been of increasing concern.

- A major constraint affecting the growth of the poultry industry in India is the lack of basic infrastructure such as storage and transportation, including cold chain. As a result, there are wide price fluctuations in the prices of poultry products, i.e., eggs and broilers.
- An inefficient marketing system- The presence of so many market intermediaries harms both the producer and the consumer.
- The price and availability of feed resources- Maize or corn plays a major role in broiler production, as it constitutes 50 to 55 percent of broiler feed. As the broiler industry is growing at the rate of 8-10 percent per annum, the demand for maize and soya is thus likely to increase.
- Emerging and re-emerging diseases of poultry- Mutations in viral genomes leading to new variants in viruses and developing resistance to vaccines and antibiotics. Avian Influenza outbreaks occurring in parts of India, is a very good example.

The policy measures that are required to improve the poultry industry must involve: (a) improving infrastructure facilities, which will help not only to stabilize the

price of poultry products in the domestic market, but will also make them available in remote areas; (b) creating an efficient marketing channel that will help provide remunerative prices to producers (in other words, India's marketing set-up should also grow along professional lines).

Conclusions

The poultry production in India continues to exhibit spectacular growth in spite of several challenges encountered over the

years. With increasing demand for chicken egg and meat, the poultry production in India foresees further expansion and industrialization. Adoption of small scale poultry farming in backyards of rural households will enhance the nutritional and economic status of the rural people. With the advent of knowledge and new discoveries in different fields of poultry, the future challenges will not be a hindrance and thus sees a bright future for poultry production in this country.

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